NOV. DEC. 1960

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A MAGAZINE DEVOTED TO THE INTERESTS OF RADIO, HI-FI AND TV TECHNICIANS IN CANADA

ROGERS BOOSTER

cover story

On Wyandotte Street in Windsor, Ontario, there is a business most anyone would be proud to own. A sign outside says "Gray's Radio & Television Service Ltd."

A TV technician himself, Jim Gray has six employees, owns the building he occupies and has five trucks and a car. He operates strictly on service—no sales—and he works for retailers and supplies car radio service for car dealers. In addition he has a substantial business among the general public.

How was this fine business built? Not with mirrors, and not because Jim Gray had any advantages other men don't have.

After attending Listowel High School he studied at the Radio College of Canada in 1935 and 1936. From 1943 to 1946 he served as a radar technician in the RCAF. Then he took a job and worked for other people until 1951.

That was when Jim got together $500, a beat-up 1940 Chevrolet and, working from his basement, started out in business. He did so well that by 1956 he had built the building he now occupies and equipped it especially for a service operation. It's on one of the main streets of east Windsor.

Jim figures his business was built largely on the R.E.T.A. warranty. He supplies free service for 30 days.

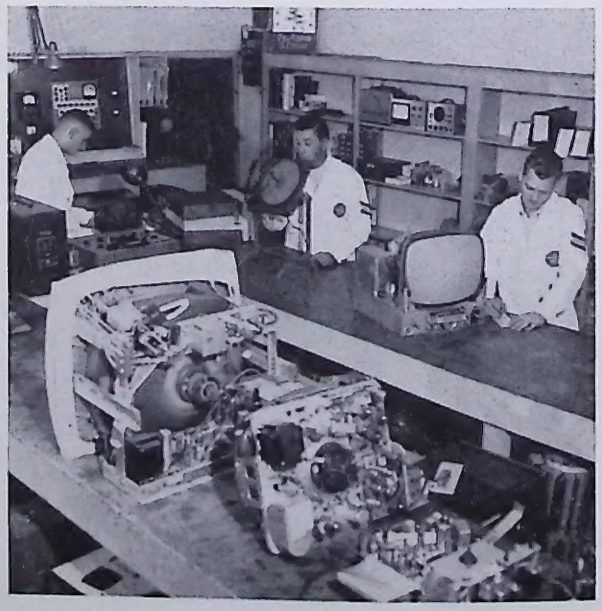
He is an active member of R.E.T.A. and chairman of the membership committee.

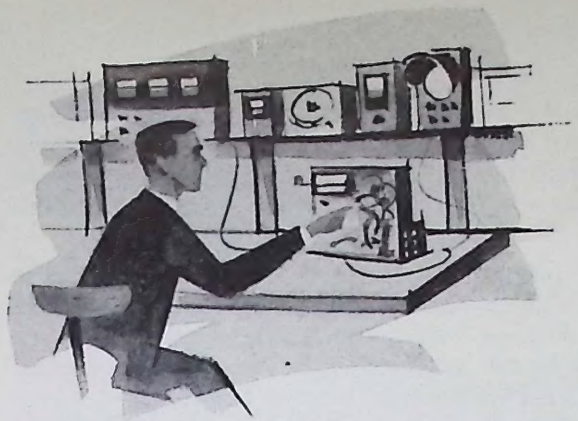
Service calls are made using his own special order form and a service record card is kept for each set repaired.

There are a good many special features about Jim Gray's operation for he believes that a good businessman should be constantly up to date and seeking new ideas for improvement. For instance, his building is designed to speed service work and increase efficiency. It even has a special exhaust fan and air compressor for the cleaning of sets.

And the business has been fully equipped and trained to service color TV for some time.

In the nearly 10 years Gray has been in business he has come a long way. He has won the liking and respect of men in his own trade, a place in his community and he has a profitable business. Gray's Radio and Television Service Ltd., Windsor, is a good example of how small business can bring a man—with reasonable investment of brains, good character and hard work, though with little capital—a very handsome return.





technical section

Servicing the Signal-seeking Tuner

Long ago, pushbutton tuning disappeared from the domestic radio but it continues to be popular in the car receiver. The reason, of course, is that the driver needs to keep his eyes on the road. On delivery of his new car, the first thing the proud owner does is to set up the pushbuttons for, say, four local or semi-local stations that he usually listens to. This is fine for going to and from work or for short trips.

But now he goes on a long trip and after a few hours he finds his preselected stations fading out. Manual tuning could be used except for the fact that he is in heavy traffic. Another possibility is to pull up at the side of the road and reset the buttons for nearer stations—if he has a list of stations and their locations. But this is no good either because, in the course of a couple hours, he will be in a new locality.

Here is where automatic tuning comes into the picture for, by means of this device, the tuning of the receiver is swept from the lowest to the highest frequency and then back again. It may be set to stop at the first local station it sweeps across or at the first clearly audible signal.

General Description

The signal-seeking tuner is an electronic and mechanical device combined with a conventional receiver so that stations are tuned in automatically. When a foot switch is pressed, the tuner begins its sweeping cycle and will continue to do so until a signal of precise input level triggers the electrical portion and stops the movement. If the motion is not stopped before the tuner reaches the high-frequency end of the dial, two solenoids will return it to the low-frequency end and "recock" the mechanism for another sweep.

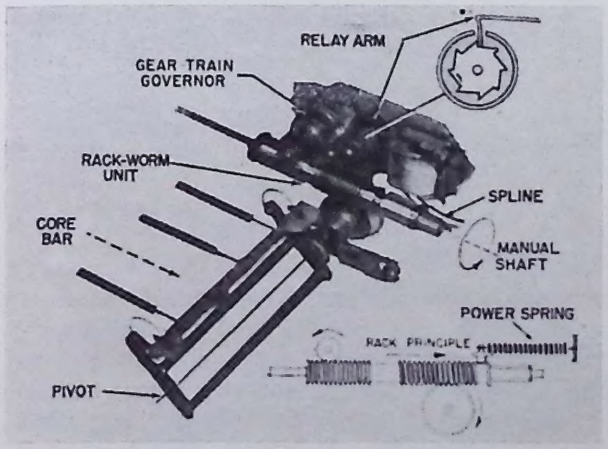


Fig. 1

The strength of the signal selected is determined by the setting of the sensitivity switch. When set for maximum sensitivity, the tuner will stop on all stations of reasonable strength in the particular area in which the receiver is operating. In the minimum position the tuner will stop only on strong or local stations. Note that this control is included in the circuit only when the receiver is in the signal-seeking position.

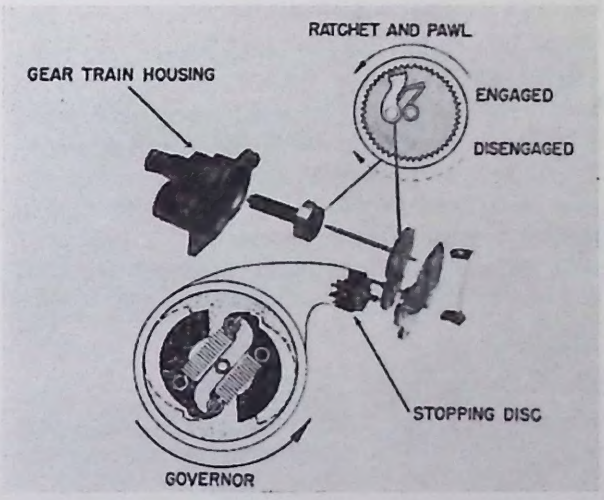


Fig. 2

The tuner also incorporates five manually-operated buttons, similar to the push-pull lockup selector buttons that have been used for many years. When one of these buttons is pressed, a declutching mechanism disengages the manual tuning control as well as the automatic tuning mechanism. Thus their operation is entirely independent of the signal-seeking arrangement.

Mechanical Operation

The driving force during the sweeping cycle is provided by a power spring and the speed of

the sweep is controlled by a governor. After sweeping to the h-f end, the return of the tuning cores and pointer to the l-f end is accomplished by energizing a solenoid. This is controlled by a limit switch which completes the circuit to the solenoid. When the l-f end is reached, this switch opens and the solenoid is de-energized.

The sweeping action is stopped and started by a relay arm. When current is cut off from the relay, its arm engages the gear train governor (see Figure 1) and prevents any motion of the gears. When the relay is energized, the arm is withdrawn and the gear train is free to govern the sweeping action.

Another solenoid is operated independently to restretch the spring after it has pulled the gear train through the tuning cycle. This calls for another limit switch.

Details of these operations are shown in Figure 1. To move the mechanism from the l-f to h-f ends of the range, the tuning cores must move in the direction indicated by the broken arrow. The spring is pulling in this direction but the gear train must first be released by withdrawing the relay arm. The governor, which is free to slide along the splined shaft, is shown in detail in Figure 2. Note that this is a centrifugal friction worm unit.

The Governor

Figure 4 shows a top view of the rack-worm unit, its linkage to the power spring and the governor gear train. Observe the governor, both here and in Figure 2. As we said before, it is a centrifugal friction type in that, as the speed increases, the blades fly out to rub against the housing and slow down the motion.

Observe also the ratchet and pawl in Figure 2. This unit is necessary because, without it, the gear train would turn in the opposite direction when the spring was being stretched by its solenoid. This is prevented by the pawl which locks with the ratchet in the driving-direction. In the reverse direction however, the pawl disengages and slips over the ratchet.

When a signal is received, the relay arm drops into the gear train and the linear movement of the rack-worm ceases.

This may sound complicated when studied from still pictures but, when the unit is on the bench and the components can be seen in motion, it is relatively simple.

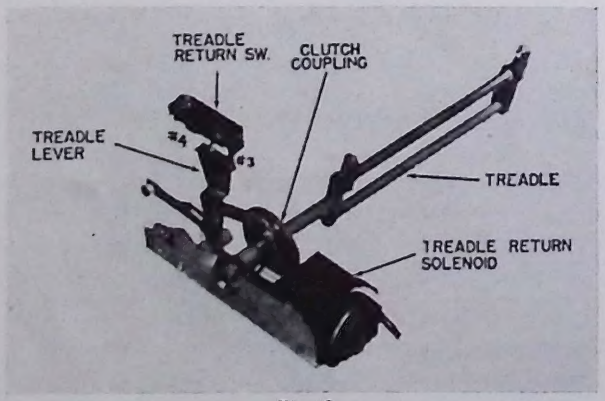


Fig. 3

Treadle Return Cycle

As we have seen, when the tuner reaches the h-f end of the dial the treadle and tuning cores must be returned to the l-f end. The treadle return solenoid, the treadle, the clutch coupling, the treadle return switch and the treadle lever are all shown in Figure 3. During the sweep cycle, the switch-operating arm #3 moves toward the switch. When the switch is thrown at the h-f limit, the solenoid is energized and turns the treadle. Meanwhile, arm #4 is approaching the switch and, when the treadle reaches the l-f end, the switch is opened and the solenoid is cut off. A dashpot damper (an air piston) helps to cushion the shock as the l-f end is reached.

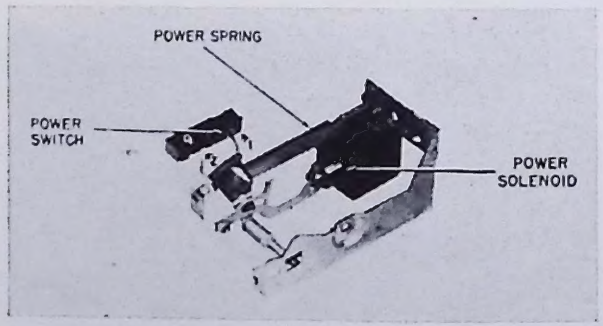


Fig. 4

The Power Cycle

When the power spring has pulled the rack-worm and treadle to the h-f end, the spring must be restretched. Figure 4 shows the power solenoid, the power spring and the power switch. As the stored energy in the spring is expended, arm #1 approaches the switch and, just when

the spring needs more energy, the switch is closed to actuate the power solenoid. Then, when the spring is fully stretched, arm #2 will reach the switch and open it.

The Clutching Operation

When the power solenoid is energized, the position of the treadle must not be disturbed. Similarly, when the treadle solenoid is energized, the rack-worm unit and the power spring must not be moved. Thus, when either solenoid is energized or pushbutton depressed, the treadle must be free to rotate. This is accomplished by the clutch lever and roller cam shown in Figure 5.

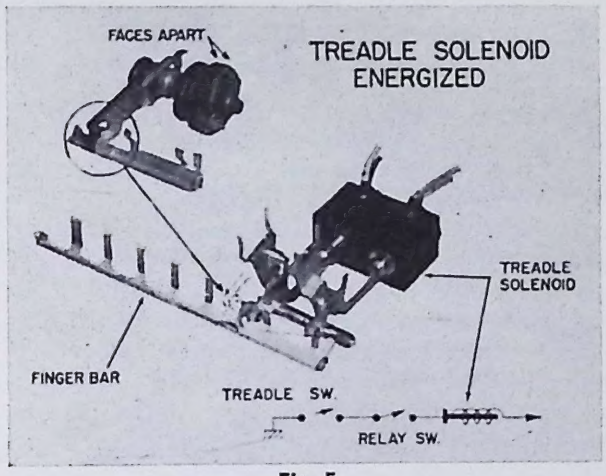


Fig. 5

When a pushbutton is depressed, the clutch faces are pulled apart by the clutch lever. When either solenoid is energized, the clutch lever is engaged by the linkage to each solenoid plunger and the clutch faces are separated so that the treadle is free. This permits the power spring to be stretched without disturbing the treadle and allows the treadle to turn without affecting the position of the power spring.

Next month we will examine the electrical portion of the mechanism and some faults that may have to be corrected.

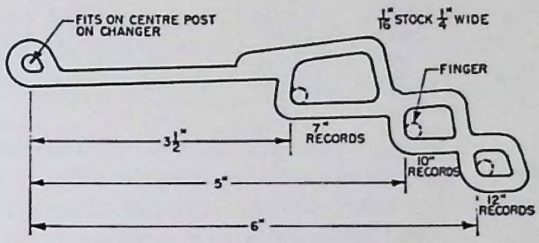
(Data and illustrations courtesy of General Motors of Canada)

Transient Capacitor

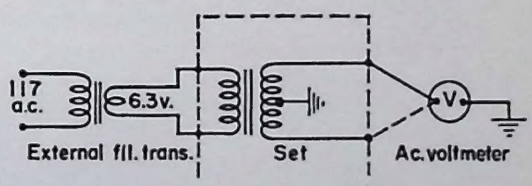
Basic circuits are familiar to any good technician and he can usually take the circuit diagram of a new TV or radio receiver and figure out its operating principles. Even variations and modifications are often obvious to the analytical mind. Sometimes, though, the designer has strayed from the beaten path in circuitry or added components

tips *for technicians*

Record changer jig – Many record changers (the Webster for example), are provided with an index finger that sets the landing point of the stylus on a record. The setting of this finger has been simplified by means of the jig shown herewith. It is cut from 1/16" stock and the distances indicated measured very carefully. The shape of the



opening is not important so long as the distance from the centre post to the corner in which the index finger cushion rests is exact. The hole in the left end fits over the changer centre post at the level of the index finger so that the finger can be set to the proper position with a minimum of fuss. To those who are familiar with these changers, the method of application will be obvious.



Quick check for a vibrator transformer– The vibrator transformer used in some battery operated receivers can be checked with a 6.3 volt filament transformer and an a.c. voltmeter. Remove the vibrator and plug the filament leads into the correct holes on the vibrator socket. Measure the voltage between ground and each plate pin on the rectifier socket. These voltages should be equal. However, some transformers will work satisfactorily with a 15 to 20 volt variation between the two halves of the secondary.

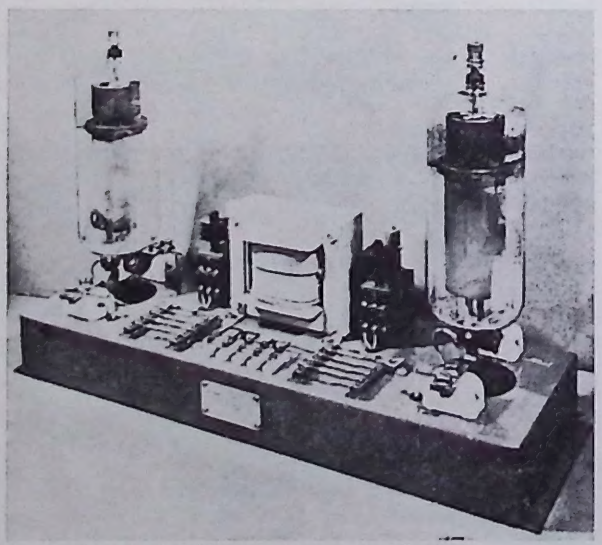
for which there is no apparent reason. Not knowing what snags were encountered during the development of the receiver, the technician feels at a loss. Fortunately, if he keeps up with his reading, he will eventually find the answer because most of our popular electronics magazines publish discussions of new circuitry.

A similar situation will be encountered by the technician when he first enters the industrial electronics field. Knowing the ultimate purpose of the device (and this we would say is a "must") he will be able to follow its operating principles stage-by-stage in most cases. But the presence of some unfamiliar components may confuse him and a typical example is the transient capacitor.

This is a ceramic or mica unit of about .01 mfd commonly appearing across the grid-cathode lugs of thyratrons used as timers or for power control.

We will assume that the reader has read at least something about thyratrons and other gas-filled tubes and knows that their grids have a control action that differs radically from that of conventional vacuum tubes. A thyratron, for example, will not conduct as long as its grid remains sufficiently negative but will become fully conductive when the grid bias reaches a certain level.

Trouble arises because this threshold is extremely sharp and, when the tube is about to conduct, a change in bias of just a fraction of a volt can push it into the conductive region. If this push comes from the proper source, all well and good. But if it comes from an external source it may well cause the tube to fire sooner than it should.



Electronic AC contactor using 2 thyratrons

The Source of the Trouble

Thyratron timers used in industrial operations are usually supplied by a 60-cycle a-c line and it may be assumed that this line will maintain its rated voltage. However, large inductive loads such as motors and welders are often connected across the same line. When these loads are switched on and off, high amplitude transient pulses are created—possibly thousands of volts. These may travel hundreds of feet down the line and, even though an isolation transformer is used, will reach the cathode-anode terminals of the thyratron. This is illustrated in Figure 1.

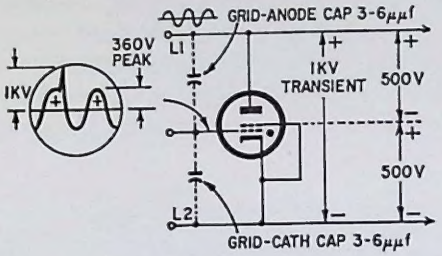


Fig. 1

The interelectrode capacitances of the tube are small but the frequency of the transient is quite high so that the two capacitances form a very nice voltage divider. Now the cathode-grid and anode-grid capacitances are just about equal and a transient that is positive to the anode can cause the grid to go positive by at least half of the transient voltage. If this occurs when the grid is normally starting to swing in the positive direction, the tube will fire for the remainder of that half cycle. Needless to say, the load is energized much sooner than it should be.

The Effect of the Transient Capacitor

Figure 2 shows the transient capacitor inserted between grid and cathode. Since .01 mfd is so very much greater than either interelectrode capacitance, the whole voltage divider arrangement is upset. The first section (grid-anode) is still of high reactance and the second section (grid-cathode) has very low reactance. The division of voltage now is such that practically none of it appears between grid and cathode.

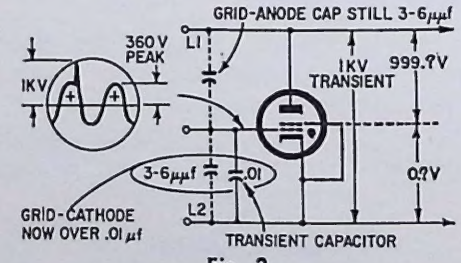
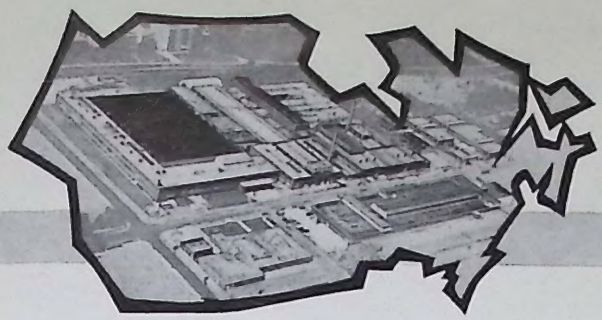


Fig. 2

What faults are likely to develop? Well, this type of capacitor doesn't fail very often and it will either short or open. If it shorts, the thyratron is dead and the fault is not hard to locate. If it opens, operation may be normal but intermittent. That is the time to look for an open capacitor.



industry news

New Canadian Electronic Tube—A Canadian-designed electronic tube to read magnetic tape was among new developments in communications electronics reported at the Canadian Symposium on Communications held in Montreal. The new tube, called Lectron, was descibed by Prof. Jean Paul Bernier, who directs the research group in the Applied Electronics Laboratory at the Ecole Polytechnique—the lab which developed it. Video recording is the only application so far considered but it is possible that the tube may be useful in other fields such as computing and control devices.

The Tunnel Diode Hits a Snag—At least two manufacturers of gallium arsenide tunnel diodes have suspended delivery of the devices pending further laboratory investigation, following the observation of a failure in peak current at high storage temperature or larger power dissipation.

New Japanese Development—Metal electrodes soldered directly onto silicon rectifier elements constitute a new manufacturing technique being used by an electronics firm in Tokyo.

Electronic Business for Canada—Lear Inc. of Grand Rapids, Michigan, recently completed a two-day symposium in Toronto designed to offer thirty-million dollars worth of business to 71 Canadian firms considered able to meet defence requirements as to price and quality. The symposium was arranged in co-operation with the Department of Defence Production.

The Color TV Fight is ON—The question of whether RCA or Philco Corp. is entitled to a patent for a system of balanced modulators to produce a compatible signal in color TV has been placed in the hands of a federal judge. At the end of a two-day trial, attorneys for the two companies were given 60 days to file briefs after they get a transcript of the court hearing.

Watch-Now, Pay-Later. A watch-now pay-later TV plan is to be installed at Sault Ste. Marie. Called Charge-a-Vision, it's planned for 5,000 homes early in 1961. Three Canadian companies are in on the pilot scheme offering subscribers recently released movies and TV programs piped in from the U.S. Subscribers will be expected to read their own meters and send in payments.

Television Ownership in Canada

	Television Homes	% of all Homes
(9 PROVINCES)†	3,423,410	80%
MARITIMES	228,930	72
PRINCE EDWARD ISLAND	14,390	62
NOVA SCOTIA	129,980	78
NEW BRUNSWICK	84,560	65
QUEBEC	983,130	88
ONTARIO	1,336,930	86
PRAIRIE PROVINCES	536,860	66
MANITOBA	159,610	69
SASKATCHEWAN	148,000	61
ALBERTA	229,250	68
BRITISH COLUMBIA	337,560	72

†Newfoundland available at later date

Montreal's New TV Station—A Toronto firm has received a $500,000 order to provide equipment for Montreal's new second-channel CFTM-TV. The order includes items of equipment that are entirely new in Canadian TV broadcasting. These include a unique continuous-motion TV film projector, a recently-developed transistorized video switcher and a special-effects generator. It is said that the new projector literally injects new life into old film, eliminating the effects of scatches and dirt particles on the film.

Substrata Radio—Work is under way on the development of underground communications which promises to provide a new "survival" system in wartime and a sizable market for peacetime products. In this system the substrata of the earth is used as a means of transmission and represents a realization of the ideas that scientists have had for many years. Because the transmitting and receiving equipment can be buried deeply in the earth, eliminating vulnerable transmission lines, the military is interested. Its commercial possibilities in mines, subways and tunnels are also obvious.

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what's NEW?

in semi-conductors, tubes and components

The 12AD6A Pentagrid Convertor

The type 12AD6A is an improved version of the 12AD6 developed by Rogers primarily for use in 3 tube hybrid car radios that do not employ an R.F. stage. It is a 7 pin miniature pentagrid convertor where plate, screen and heater are operated directly from the 12 volt battery.

In addition, when operated in receivers with no R.F. stage, the 12AD6A, due to its super remote cut-off characteristics, does not cut off completely. The 12AD6, on the other hand, due to its sharper cut-off, requires AGC to be applied to the R.F stage in order that it not be overloaded on strong signals.

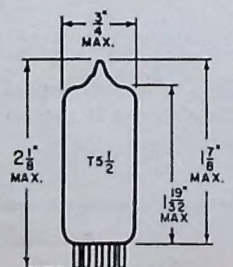
This necessitates careful control of grid 3 characteristics, as noted below, in order to obtain satisfactory performance without spurious heterodyne signals (tweets) and overload distortion. Freedom from overload distortion must be maintained over the wide range of battery voltage from 10.0 to 15.9; the plate cut-off current characteristic when plotted against $-Eg_3$ must exhibit a straight line between -4 to -8 volts.

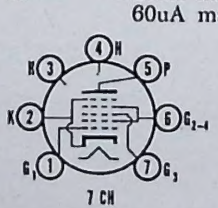
A low level of distortion is maintained by establishing an optimum ratio between plate current and screen current. It requires rigid control of contact potential and its stability during life. These conditions are established and successfully controlled in Rogers tubes.

12AD6A tubes exhibit uniform high sensitivity. This feature is achieved in production by rigorous control of space charge.

Typical operational conditions are identical to those published for 12AD6 tube type with special provision for Ib_3 cut-off current:

Ef	= 12.6 Vdc	$-Eg_1$	= 1V
Eb-Eg	= 12.6 Vdc	$-Eg_3$	= 6V
		Ib	= 25uA min.
			60uA max.



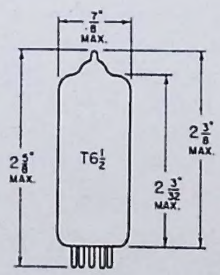


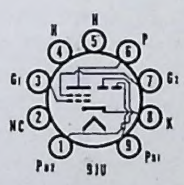
12DS7A Twin-Diode Power Tetrode

The introduction of the transistor in 1948 has had a profound effect upon the design of car radios and has resulted in the evolution of several new tube types designed specifically for operation with transistors at a B+ voltage of 12.6 volts.

One of the most interesting of the new tubes is the Rogers made 12DS7A which is used in 1 in every five new Canadian car radios. It comprises two diodes and a high perveance space-charge power tetrode on a 9-pin miniature base. The diode units are used for A.M. signal detection and automatic volume control, while the tetrode unit serves as driver for the A.F. power output transistor stage. The 12DS7A gives a higher performance than the American 12DS7, with a grid #2 to plate transconductance of 19,000 micromhos as compared to 15,000 in the 12DS7.

Space-charge-grid operation of the tetrode unit is obtained by operating the 150 t.p.i. grid #1 at B+ voltage and utilizing grid #2 as the control electrode. The grid #1 draws approximately 80mA and the electrons passing through it form a space charge of low density since the electron stream is broken up into finely divided sheaths. This space charge, together with the grid #2 and plate, form a triode of very high perveance and gives approximately 35mA of plate current at 12.6 volts. This feature, together with high transconductance and a plate resistance of 500 ohms enable this tube to supply high input power at low distortion to the transistor.





Characteristics, Class A, with Ef = 12.6 volts

Plate voltage	12.6 volts
Grid #2 voltage (developed across a 2.2 megohm resistor)	-0.5 volts
Grid #1 voltage	12.6 volts
Plate resistance (approx.)	500 ohms
Amplification factor, grid #2 to plate	9.1
Transconductance, grid #2 to plate	19000 micromhos
Plate current	35mA
Grid #1 current	75mA

Published by Rogers Electronic Tubes & Components, a Division of Philips Electronics Industries Ltd., 116 Vanderhoof Ave., Toronto 17, Ontario.